

**USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY16 Final Performance Report  
Due date: July 28, 2017**

**Cover Page**

<b>Principle Investigator (PI):</b>	Floyd Dowell
<b>Institution:</b>	USDA-ARS
<b>E-mail:</b>	floyd.dowell@ars.usda.gov
<b>Phone:</b>	785-776-2753
<b>Fiscal Year:</b>	2016
<b>USDA-ARS Agreement ID:</b>	N/A
<b>USDA-ARS Agreement Title:</b>	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.
<b>FY16 USDA-ARS Award Amount:</b>	\$ 21,600

**USWBSI Individual Project(s)**

<b>USWBSI Research Category*</b>	<b>Project Title</b>	<b>ARS Award Amount</b>
HWW-CP	Single Kernel NIR Sorting Technology for Enhancing Scab Resistance and Grain Quality.	\$ 21,600
	<b>FY16 Total ARS Award Amount</b>	<b>\$ 21,600</b>

**Floyd Dowell**

Digitally signed by Floyd Dowell  
DN: cn=Floyd Dowell, o=USDA ARS, ou=SPIERU,  
email=floyd.dowell@ars.usda.gov, c=US  
Date: 2017.07.26 15:52:18 -05'00'

Principal Investigator

Date

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\* MGMT – FHB Management  
FST – Food Safety & Toxicology  
GDER – Gene Discovery & Engineering Resistance  
PBG – Pathogen Biology & Genetics  
EC-HQ – Executive Committee-Headquarters  
BAR-CP – Barley Coordinated Project  
DUR-CP – Durum Coordinated Project  
HWW-CP – Hard Winter Wheat Coordinated Project  
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:  
    SPR – Spring Wheat Region  
    NWW – Northern Soft Winter Wheat Region  
    SWW – Southern Soft Red Winter Wheat Region

**Project 1:** *Single Kernel NIR Sorting Technology for Enhancing Scab Resistance and Grain Quality.*

**1. What are the major goals and objectives of the project?**

To develop/improve NIRS techniques for evaluation of DON levels in wheat grains and using those NIR techniques for developing methods to assess FHB resistance components in wheat breeding materials to help streamline development of FHB resistant wheat cultivars.

**2. What was accomplished under these goals?** *Address items 1-4) below for each goal or objective.*

1) major activities

We studied the influence of variability in moisture content of kernels at the time of analysis on the performance of NIR calibration for estimating DON levels in single wheat kernels.

We completed a 4-season study using FTNIR spectroscopy to evaluate DON levels in bulk wheat grain samples from FHB nursery trials.

We developed a NIR technique to evaluate FHB resistance to disease spread and resistance to DON accumulation in wheat germplasm by using artificially inoculated wheat spikes.

2) specific objectives

To study the influence of variability of grain moisture levels on the performance of DON calibration and to suggest measures to adopt and to identify future research needs to mitigate the effects of external variables to further improve single kernel DON calibration.

To develop a method to rapidly estimate the DON levels in FHB nursery samples to prescreen those and to identify the best lines for advancement by culling those with high DON levels.

To develop a technique for rapid evaluation of wheat germplasm for resistance to disease spread within spikes and resistance to DON accumulation in infected kernels.

3) significant results

Variations in kernel moisture levels should be taken into account when developing NIR calibrations and when those calibrations are used for estimating DON levels in grain samples. Best results are obtained when samples being analyzed have the moisture levels similar to the moisture levels of the calibration samples. NIR spectroscopy can also be used to accurately estimate moisture contents of kernels being analyzed for DON levels concurrently. Therefore, further research is needed to study use of novel statistical methods to remove the effects of moisture variation in kernels on NIR calibration.

FTNIR DON calibration can be used to rapidly estimate DON levels in bulk grain samples from FHB nursery trials and may be used for prescreening nursery samples by identifying high- and low-DON samples.

Single kernel DON calibration can be used for evaluation of DON levels in artificially inoculated wheat spikes and this technique can be used for objective assessment of wheat germplasm for FHB resistance to disease spread and resistance to DON accumulation.

4) key outcomes or other achievements

Moisture levels of kernel samples should be considered when using NIR calibrations for DON estimation. Samples should be stabilized to 13-14% moisture levels before using our current DON calibration. The outcome from this research is useful for those developing new instruments/calibrations for estimating DON in cereal grains.

FTNIR DON calibration may be useful for wheat breeders and plant pathologists to prescreen FHB nursery samples. This will allow them to identify the best low-DON lines to advance to the next generation by reducing time and costs associated with DON analysis of all samples using standard laboratory methods.

Plant breeders can use the NIR technique for evaluation of wheat germplasm for FHB resistance to disease spread and resistance to DON accumulation. A PhD student and a MS student have used this technique in their studies for mapping genes responsible for FHB resistance to DON accumulation in selected Kansas wheat cultivars.

**3. What opportunities for training and professional development has the project provided?**

This project provided training for one postdoctoral research associate and two graduate students to use NIR and IR spectroscopy techniques for evaluation of FHB resistance in wheat.

**4. How have the results been disseminated to communities of interest?**

Three peer review publications in Cereal Chemistry journal, posters and presentations in meetings.

One research publication was highlighted in industry magazine Cereal Foods World [New NIR spectroscopy method shines light on new method for breeding DON resistance CFW 62 (3):125]. Two of the three research publications in Cereal Chemistry journal were among the 20 most downloaded articles as of July 2017.

## **Training of Next Generation Scientists**

**Instructions:** Please answer the following questions as it pertains to the FY16 award period. The term “support” below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student’s stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

- 1. Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY16 award period? No**

**If yes, how many?**

- 2. Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY16 award period? No**

**If yes, how many?**

- 3. Have any post docs who worked for you during the FY16 award period and were supported by funding from your USWBSI grant taken faculty positions with universities? No**

**If yes, how many?**

- 4. Have any post docs who worked for you during the FY16 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies? No**

**If yes, how many?**

### Release of Germplasm/Cultivars

**Instructions:** In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY16 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.*

Name of Germplasm/Cultivar	Grain Class	FHB Resistance (S, MS, MR, R, where R represents your most resistant check)	FHB Rating (0-9)	Year Released

Add rows if needed.

**NOTE:** List the associated release notice or publication under the appropriate sub-section in the ‘Publications’ section of the FPR.

**Abbreviations for Grain Classes**

- Barley - BAR
- Durum - DUR
- Hard Red Winter - HRW
- Hard White Winter - HWW
- Hard Red Spring - HRS
- Soft Red Winter - SRW
- Soft White Winter - SWW

## **Publications, Conference Papers, and Presentations**

**Instructions:** Refer to the FY16-FPR\_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY16 grant. Only include citations for publications submitted or presentations given during your award period. If you did not have any publications or presentations, state ‘Nothing to Report’ directly above the Journal publications section.

### **Journal publications.**

Peiris, K. H. S., Y. Dong, M. A. Davis, W. W. Bockus and F. E. Dowell (2017) Estimation of the Deoxynivalenol and Moisture Contents of Bulk Wheat Grain Samples by FT-NIR Spectroscopy. *Cereal Chemistry* 94(4):677-682.

Status: Published

Acknowledgement of Federal Support: YES

Peiris, K. H. S., Y. Dong, W. W. Bockus and F. E. Dowell (2016) Moisture Effects on the Prediction Performance of a Single Kernel Near-Infrared Deoxynivalenol Calibration. *Cereal Chemistry* 93(6):631-637.

Status: Published

Acknowledgement of Federal Support: YES

Peiris, K. H. S., W. W. Bockus and F. E. Dowell (2016) Near infrared spectroscopic evaluation of single kernel deoxynivalenol accumulation and Fusarium head blight resistance components in wheat. *Cereal Chemistry* 93(1):25-31.

Status: Published

Acknowledgement of Federal Support: YES

### **Books or other non-periodical, one-time publications.**

Clinesmith, M., 2016. Genetic mapping of QTL for Fusarium head blight resistance in winter wheat cultivars Art and Everest (MS dissertation, Kansas State University).

Status: Unpublished dissertation available at K-state Krex

<https://krex.k-state.edu/dspace/browse?value=Clinesmith%2C+Marshall&type=author>

Acknowledgement of Federal Support: YES

### **Other publications, conference papers and presentations.**

Cristiano Lemes da Silva, Allan Fritz, Jesse Poland, Floyd Dowell and Kamaranga Peiris (2016) “Mapping of Fusarium Head Blight Resistance and Deoxynivalenol Accumulation in Kansas Wheat.” In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), *Proceedings of the 2016 National Fusarium Head Blight Forum* (p. 60). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Status: Abstract published

Acknowledgement of Federal Support: YES

Cristiano Lemes, Allan Fritz, Jesse Poland, Floyd Dowell and Shantha Peiris (2016) “Mapping of Fusarium Head Blight Resistance and Deoxynivalenol Accumulation in Kansas Wheat.” *Improving Efficiency in Breeding Programs: National Association of Plant Breeders 2016 Annual Meeting Poster Abstracts*. 15-18 August, 2016. Raleigh, NC.

Status: Abstract published

Acknowledgement of Federal Support: YES